

**UNCLASSIFIED**

---

---

**AD 297 326**

*Reproduced  
by the*

**ARMED SERVICES TECHNICAL INFORMATION AGENCY  
ARLINGTON HALL STATION  
ARLINGTON 12, VIRGINIA**



---

---

**UNCLASSIFIED**

**NOTICE:** When government or other drawings, specifications or other data are used for any purpose other than in connection with a definitely related government procurement operation, the U. S. Government thereby incurs no responsibility, nor any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use or sell any patented invention that may in any way be related thereto.

CATALOGED BY ASTIA  
AS AD 297326

63-2-5

GIIIID

GENERAL DYNAMICS | CONVAIR

Report No. 8926-096

Materials - Laminates - Fiberglass - Polyester Resin  
(No. 190-2, Fiberesin Plastics Co.)

Qualification Tests (Mil-P-8013C, Type I)

G. E. Gardner, Jr., P. W. Bergstedt, H. C. Turner

297326

1 April 1959



Published and Distributed  
under  
Contract AF33(657)-8926

**G**  
**GENERAL DYNAMICS | CONVAIR**

MODEL  
DATE

PAGE  
REPORT NO.

Report No. 8926-096  
Materials - Laminates - Fiberglass - Polyester Resin  
(No. 190-2, Fiberesin Plastics Co.)

Qualification Tests (Mil-P-8013C, Type I)

Abstract

Fiberglass-polyester resin laminates consisting of twelve plies of No. 181 Volan A fiberglass fabric impregnated with No. 190-2 polyester resin (Fiberesin Plastics Co., Oconomowoc, Wisconsin) were fabricated by vacuum bag curing under 26 inches of mercury at 275°F for 1 hour. The results of the several tests made are as follows:

1. Room Temperature Conditions

Specific Gravity = 2.22

Resin Content = 40.4%

Barcol Hardness = 67.0

Flexural Flatwise Ultimate Strength, ksi = 64.9

Flexural Initial Modulus of Elasticity, psi  $\times 10^6$  = 2.8

Compression Ultimate Strength Edgewise, ksi = 53.6

Tensile Ultimate Strength, ksi = 44.1

2. Wet Condition

Flexural Flatwise Ultimate Strength, ksi = 59.2

Flexural Initial Modulus of Elasticity, psi  $\times 10^6$  = 2.6

Compression Ultimate Strength Edgewise, ksi = 50.8

Tensile Ultimate Strength, ksi = 43.5

References: Gardner, G. E., Jr., Bergstedt, P. W., Turner, H. C., "Qualification Test of Laminates of Fiberglass Cloth No. 181, Volan A, With Polyester 190-2 Resin (Mil P-8013C, Type I)," General Dynamics Convair Report MP59-028, San Diego, California, 1 April 1959, (Reference attached).

**CONVAIR**  
A DIVISION OF GENERAL DYNAMICS CORPORATION  
**SAN DIEGO**



STRUCTURES & MATERIALS LABORATORIES

REPORT MP 59-028

DATE 1 April 1959

MODEL ALL

T. N. MP-57-627

**TITLE**

REPORT NO. MP 59-028

QUALIFICATION TEST OF/  
LAMINATES OF FIBERGLAS  
CLOTH NO. 181 VOLAN, A, WITH  
POLYESTER 190-2 RESIN.  
MIL-P-8013c, TYPE I

MODEL: ALL

PREPARED BY

*G. E. Gardner Jr.*  
G. E. Gardner Jr.

GROUP Materials & Processes Lab.

CHECKED BY

*P. W. Bergstedt*  
P. W. Bergstedt

REFERENCE \_\_\_\_\_

CHECKED BY

*H. C. Turner*  
H. C. Turner

APPROVED BY *E. F. Strong*  
E. F. Strong, Chief  
of Structures & Materials Lab.

CHECKED BY

*W. M. Sutherland*  
W. M. Sutherland, Grp. Engr.

NO. OF PAGES 4

NO. OF DIAGRAMS 2

**REVISIONS**

NO.	DATE	BY	CHANGE	PAGES AFFECTED
1	4-22-59	WMS	T.N. MP-57-627 added to Title Page	Title Page

ANALYSIS  
PREPARED BY Gardner  
CHECKED BY Bergstedt/Turner/Sutherland  
REVISED BY

C O N V A I R  
AN AIRCRAFT DIVISION OF GENERAL DYNAMICS CORPORATION  
SAN DIEGO

PAGE 1  
REPORT NO. MP 59-028  
MODEL All  
DATE 4-1-59

OBJECT:

The qualification to Specification Mil-P-8013c, Type I, of laminates of fiberglass cloth No. 181 (CVAC-1000-5) impregnated with Polyester 190-2 Resin, manufactured at Convair, San Diego, California.

CONCLUSION:

Laminates of fiberglass cloth No. 181 (CVAC-1000-5) and Polyester 190-2 Resin, fabricated by Dept. 129, Convair, San Diego, California, satisfactorily conformed to minimum mechanical property requirements of Military Specification Mil-P-8013c, Type I.

TEST PANELS:

One panel, 0.132 inches in thickness by 15 inches square, was submitted to the Materials and Processes Laboratory on February 20, 1959 by the fabricator, the Production Plastics Manufacturing Dept. No. 129 of Convair, San Diego.

This laminate was submitted as a wet lay-up, nominally two feet square, consisting of twelve (12) plies of No. 181 glass fabric impregnated with Polyester 190-2 Resin.

The laminate was cured by employing the flat vacuum bag process. Contact pressure was maintained for one (1) hour at 24 inches of mercury; curing temperature was held at 275°F. ± 10°F. Laminating and curing procedures followed the resin manufacturer's (Fiber-Resin Corp.) process recommendations.

TEST SPECIMENS:

Ten (10) flexural, ten (10) compression, and ten (10) tensile specimens were machined from the submitted panel with the long direction parallel to the warp thread direction of the laminate. Prior to testing, five (5) specimens of each type were placed in boiling distilled water for two (2) hours. The second set of five (5) specimens of each type was tested in the standard condition.

PROCEDURE:

The length of each flexural specimen was equal to the span length plus two inches, and the width was three-fourths (3/4) of an inch. The span length had a constant length/thickness ratio of 16-18 to 1. The specimens were center-loaded, and load-deflection data were taken until failure. The speed of testing was regulated to produce a unit rate of outer-fiber strain of 0.010 inch per inch per minute. Tests were conducted in accordance with Method 1031 of Federal Specification LP-406B.

ANALYSIS  
PREPARED BY  
CHECKED BY  
REVISED BY

Gardner  
Bergstedt/Turner/Sutherland

C O N V A I R  
A DIVISION OF VERTOL AIRCRAFT CORPORATION  
SAN DIEGO

PAGE 2  
REPORT NO. MP-59-028  
MODEL ALL  
DATE 4-1-59

PROCEDURE: (Continued)

Tensile tests were performed in a Tinius Olsen Tensile Machine, and a uniform crosshead travel of 0.05 inch per minute was applied until failure. Tests were conducted in accordance with Method 1011 (LP-406B).

Compression specimens were loaded in a compression jig at a speed of 0.050 inches per minute cross-head travel until failure. Tests were conducted in accordance with Federal Specification LP-406B.

The examinations for percent of resin content and specific gravity were determined by procedures in Method 5011 (Specific Gravity) and Method 7061 (Resin Content) of Federal Specification LP-406B.

Barcol hardness was determined by direct reading with a Barcol Impres-  
sor.

RESULTS:

The results of tension, compression, and flexural tests in the standard condition are shown in Table I. The results of tension, compression, and flexural tests on specimens subjected to two (2) hours in boiling distilled water (wet condition) are shown in Table II. The results of observations made on the submitted panel for specific gravity, resin content, and Barcol Hardness are shown in Table I.

NOTE: The data from which this report was prepared are recorded in Materials & Processes Laboratory Notebooks No. 996.

ANALYSIS  
PREPARED BY  
CHECKED BY  
REVISED BY

C O N V A I R  
A DIVISION OF GENERAL DYNAMICS CORPORATION  
SAN DIEGO

PAGE 3  
REPORT NO.  
MODEL ALL  
DATE

TABLE I

QUALIFICATION TEST FOR LAMINATED (181)  
GLASS FABRIC MADE WITH POLYESTER 190-2

TESTED UNDER STANDARD CONDITIONS

SPECIFIC GRAVITY ----- 2.22

RESIN CONTENT ----- 40.4 %

BARCOL HARDNESS READING ----- 67.0

TYPE OF TEST	SPEC. NO.	MIN. REQUIREMENTS	TEST RESULTS
FLEXURAL FLATWISE ULTIMATE STRENGTH, PSI.	1	50,000	66,800
	2		62,100
	3		64,000
	4		66,500
	5		65,200
	AVERAGE		64,900
FLEXURAL INITIAL MODULUS OF ELASTICITY, PSI.	1	$2.7 \times 10^6$	$2.8 \times 10^6$
	2		$2.9 \times 10^6$
	3		$2.8 \times 10^6$
	4		$2.8 \times 10^6$
	5		$2.7 \times 10^6$
	AVERAGE		$2.8 \times 10^6$
COMPRESSION ULTIMATE STRENGTH EDGEWISE, PSI.	1	35,000	55,600
	2		50,600
	3		54,300
	4		52,700
	5		55,600
	AVERAGE		53,600
TENSILE ULTIMATE STRENGTH, PSI.	1	40,000	43,000
	2		46,200
	3		42,700
	4		44,900
	5		43,500
	AVERAGE		44,100

ANALYSIS  
PREPARED BY  
CHECKED BY  
REVISED BY

C O N V A I R  
A DIVISION OF GENERAL DYNAMICS CORPORATION  
SAN DIEGO

PAGE 4  
REPORT NO.  
MODEL ALL  
DATE

TABLE II  
QUALIFICATION TEST FOR LAMINATED (181)  
GLASS FABRIC MADE WITH POLYESTER 190-2

TESTED UNDER WET CONDITION

TYPE OF TEST	SPEC. NO.	MIN. REQUIREMENTS	TEST RESULTS
FLEXURAL FLATWISE ULTIMATE STRENGTH, PSI.	1 2 3 4 5 AVERAGE	45,000	57,700 59,300 60,800 59,100 58,900 59,200
FLEXURAL INITIAL MODULUS OF ELASTICITY, PSI.	1 2 3 4 5 AVERAGE	$2.5 \times 10^6$	$2.6 \times 10^6$ $2.6 \times 10^6$ $2.6 \times 10^6$ $2.6 \times 10^6$ $2.6 \times 10^6$ $2.6 \times 10^6$
COMPRESSION ULTIMATE STRENGTH EDGewise, PSI.	1 2 3 4 5 AVERAGE	30,000	49,100 52,400 47,900 53,200 51,600 50,800
TENSILE ULTIMATE STRENGTH, PSI.	1 2 3 4 5 AVERAGE	38,000	41,300 43,800 43,700 43,500 45,300 43,500